of the late Miss Julia Lockwood for the foundation of a scholarship.

FUNDS given by friends of Smith College for a new dormitory will, it is said, be used for a chemical laboratory. It is hoped to secure some $30,000 for the building.

WE regret that the announcement made to the effect that Mr. S. B. Brownell had presented Barnard College with a building for a dormitory is incorrect. It had its origin probably in the fact that plans have been filed for the west wing of the new buildings of Barnard College, given by Mrs. Fiske, which will be temporarily used as a dormitory.

THE sixth annual summer school held at the University of Minnesota, Minneapolis, has just closed one of the most successful sessions of its history. The school is organized in two sections, an elementary section and a university section. The enrollment of the university section in the several scientific subjects was as follows:

General Chemistry; Professor Frankforter	40
Entomology; Mr. Oestlund	14
General Geology; Professor Hall	38
Physiology; Professor Nachtrieb	18
Plant Physiology; Mr. Ramaley	12
Physics; Professor Jones	30

AT the recent Zionist conference for the colonization of Palestine by the Jews at Bâle, a commission was appointed to report upon the establishment of a university at Jerusalem.

A SPECIAL commission will meet shortly at St. Petersburg to discuss the introduction of universal and compulsory education in Russia.

DISCUSSION AND CORRESPONDENCE.

OBSERVATIONS OF THE PASSAGE OF MIGRATING BIRDS ACROSS THE LUNAR DISK ON THE NIGHTS OF SEPTEMBER 23 AND 24, 1896.

THE time is at hand when records of the transit of migrating birds across the moon's face may be secured, and I desire to put on record the following measurements, made last year, which may be of assistance to observers. All records show that the migration takes place at night, at least in the case of the smaller birds, and the dates immediately preceding and following the full of the Moon, with probably a certain amount of latitude for weather and temperature, are the ones chosen.

The instrument used in these observations was the finder of the equatorial of the Ladd Observatory. Its aperture is 4 inches, and the magnifying power was 40 diameters. When focussed on the Moon, the eye-piece had to be pulled out 1.74 inches, and the principal focal length was 4 ft. 9.59 ins.

The observations may be divided into three groups:

a. 7:45 to 8:15 Eastern M. T., Sept. 23d.
b. 8:15 to 9:15 " " " "
c. 7:45 to 8:15 " " " 24th.

The apparent altitudes and azimuths of the Moon were:

Sept. 23, 7:45, altitude = 19°.0, azimuth N. 88°.0 E.
" " 8:15, " 24°.6, " S. 87°.1 E.
" " 9:15, " 35°.4, " S. 76°.8 E.
Sept. 24, 7:45, " 14°.6, " N. 79°.9 E.
" " 8:15, " 19°.8, " N. 82°.3 E.

The mean altitudes were:

Period *a* (½ hour) 21°.8 above the true horizon.
b (1 hour) 30°.0 " " " "
c (½ hour) 17°.2 " " " "

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The flights were so rapid that it was thought best to attempt nothing more than hasty comparisons with prominent lunar features in order to get estimates of the apparent size of the birds. Three points were selected for this purpose:

Aristarchus (longer inside diam.) approximately	0′.3
Copernicus " " " "	0′.6
Mare Crisium " " " "	3′.0

Times were estimated by a chronometer audibly beating half seconds.

First night, September 23d. From 7:45 to 8:15 scarcely a minute passed without the passage of several birds, in groups numbering from one to five or six in immediate succession. It was obvious that the birds traveled in little companies. After perhaps a minute without any, one would appear, followed by four or five more in the next ten seconds—perhaps members of one family keeping near each other to relieve the loneliness of the long journey. The great majority traveled from north to south. Few deviated more than 20° or 30° from this

direction, and none were seen to move in the opposite direction. The majority were less than one-half second in crossing the Moon's disk (diameter = 29′.5). Quite a considerable number traversed the disk in 0.1 or 0.2 second. Few were as slow as 1 second and only one required 2 to 3 seconds. In this case the trajectory may have approached the line of sight. A majority appeared very small, not larger than Aristarchus (or 0′.3); few equaled Copernicus (or 0′.6); one only had a spread of wings equal to the longer diameter of the Mare Crisium (or 3′.0). In this case the wings were sharply seen when the focus was 0′.21 longer than the principal focal length. For most of the birds the focus scarcely required changing from that for the Moon's surface. Some of the swiftest flights were made by birds of the smallest apparent size.

After 8:15, as the moon rose higher (altitude 25° to 35°), the number of birds diminished; and at 9:15 intervals of 2 to 5 minutes elapsed between successive birds. The travelers no longer came in groups. Evidently the angular area of the Moon no longer filled the distance between the mean trajectories of the members of a group. The average size was larger, more nearly that of Copernicus; one bird, badly out of focus, equaled the Mare Crisium in size.

At 9:15 the observations were discontinued, as the intervals were continually getting longer.

Second night, September 24th. The watch was commenced at 7:45 with the Moon at a lower altitude than on the previous evening. The birds were less numerous, and after a half hour at 8:15, clouds began to gather, which soon completely covered the sky. In this half hour not over a dozen birds were seen. Two of these moved from south to north, traversing the diameter of the lunar disk in about 3 seconds. These were the only birds seen flying north on either evening, and the slowness of their speed indicates that they were probably moving more nearly in the line of sight (or east and west). Every flutter of the wings was plainly visible with the telescope at its lunar focus. One bird, of an expanse equal to that of the Mare Serenitatis, was blurred beyond recognition, and was evidently close at hand. One had the wavering flight of the goldfinch, and a diameter equaling that of Aristarchus (or 0.′3).

It seems possible that the prospect of cloudy weather may have deterred the migrating birds from starting on this evening. The interval from sunset to moonrise was also longer (48 minutes as against 24 minutes on the previous evening).

I now proceed to the reduction of these estimates, taking first the case of the single bird whose motion was slow enough to permit an exact adjustment of the focus, the focal length having to be increased for the bird from 57.59 inches to 57.80 inches. The bird was nearly end on. Assuming its real spread to have been 12 inches, and comparing its estimated angular diameter with the radius of a circle we have its

$$\text{distance} = \frac{3437.7}{3.0} = 1146 \text{ feet.}$$

Reversing the process, we have from the law of lenses,

$$\text{Conjugate focal length} = 1321 \text{ feet,}$$

which would make the spread

$$\frac{1321}{1146} + 12 = 13.8 \text{ inches.}$$

The spread of a robin is 16 inches, and the bird may have been of the size of a thrush.

The majority of the flights were at right angles to the line of sight, and the lengths of our smaller birds (warblers, flycatchers, etc.) being from 5 to 7 inches, I shall assume an average true size of 6 inches, and an apparent (angular) dimension of 0′.3 in periods *a* and *c*, with a mean altitude of 20°; while towards the close of period *b*, the altitude had increased to 35°, and the mean apparent angular diameter began to approach 0′.6. This gives for distances

$$\text{(a) and (c)} \quad \frac{3437.7}{0.3} \times \tfrac{1}{2} = 5729.5 \text{ feet,}$$

$$\text{(b)} \quad \frac{3437.7}{0.6} \times \tfrac{1}{2} = 2864.8 \text{ feet,}$$

and for the heights of the birds above the observer's level (235 feet above sea-level,

$$\text{(a) and (c)} \quad 5729.5 \times \sin 20° = 1959.6 \text{ feet,}$$

$$\text{(b)} \quad 2864.8 \times \sin 35° = 1643.2 \text{ feet.}$$

These measurements indicate an altitude of about 200 feet above sea-level as the average

height of the migratory flight of the smaller birds. Of course, if the dimensions were greater than those assumed, the altitudes must be correspondingly increased, but the largest bird, whose distance was determined by the focal adjustment already described, had an altitude above sea-level of

$$(1321 \times \sin 20°) + 235 = 687 \text{ feet},$$

and was certainly much lower than the smaller birds.

The speeds can be roughly estimated from the times of transversing the lunar diameter (29′.5). This time was on the average about one-half second, giving

$$\text{velocity} = \frac{29.5}{0.3} \times \tfrac{1}{2} \text{ ft. per } \tfrac{1}{2} \text{ sec.}$$
$$= 98.4 \text{ feet per second},$$
$$= 67 \text{ miles per hour}.$$

But the swiftest flights, with every allowance for the difficulty of their estimation, were at least twice as rapid, which, if the distance were the same, would imply a velocity of at least 134 miles per hour. Some of the swifter trajectories may have belonged to very small birds at lower altitudes and smaller distances, but I have already assumed a size which is nearly that of our smallest birds. Any increase in the estimate of size enlarges that of distance and velocity. I am not ready to admit the probability of an error of judgment in the estimation of apparent sizes of as much as 100 per cent, and I have already increased the more vulnerable time-estimate for the swiftest flight from 0.15 to 0.25 seconds. Judging from the appearance of many of these darting specks, and with every allowance for errors of estimation, I am of the opinion that some of these apparent velocities are real, and that certain small birds (not the swifter swallows, humming birds and swifts, for these have all gone a month before the dates in question) can maintain a flight of 100 miles per hour without being stripped of their feathers.

In SCIENCE for January 1, 1897 (Vol. 5 N. S., p. 26), Mr. H. H. Clayton gives the height of a flock of ducks, flying southwest in December, as 958 feet above the Neponset valley, and the velocity as 47.8 miles per hour; and in SCIENCE for April 9, 1897 (Vol. 5 N. S., p. 585), the same observer gives the height for a flock of geese, migrating northeastward in March, as 905 feet above the Neponset valley, or 960 feet above sea-level, and the velocity of flight as 44.3 miles per hour. It thus appears probable that the larger birds migrate at a lower altitude than the smaller ones, and at not over half the speed of the swiftest flights.

Even more remarkable than the speed of migration are the psychological problems involved in these semi-annual movements of enormous multitudes of creatures. There was, to me, something awe-inspiring in this spectacle of a throng of tiny beings launching out into the unknown deep, in pale moonlight and through the hours commonly given to sleep, flitting swiftly and unerringly to a far-off goal, while beneath, and heeding them not, slumbered a dreaming world. What mighty impulse of daring is this which can transform a timorous sparrow, content all day to hop from bough to bough near to its nest and mate, into a bold adventurer, starting out, Columbus-like, on a voyage of discovery? If it were a matter of individual courage and wisdom, we men might shrink from the comparison—the ardor, the inerrancy, are so superhuman. Rather must we liken the migratory impulse to an irresistible force, drawing the winged wayfarers into its current, and bearing them they know not whither. It must not be forgotten that for the young birds, constituting no small number of the host, this journey is absolutely new, and not the result of experience. If the movement were the result of knowledge and trust, we might well exclaim: Oh to be as confident of eternal beneficence, and as full of foresight as are these little wanderers!

FRANK W. VERY.

LADD OBSERVATORY,
PROVIDENCE, R. I., September 3, 1897.

SCIENTIFIC LITERATURE.

Year-book of the United States Department of Agriculture, 1896. [1897.]

In the preface to this volume, Mr. Charles W. Dabney, Jr., remarks that it falls far short of the ideal set for it, and regrets that it was not possible to give it more 'editorial revision' than it has received. We may all hope with